



RCA INSTITUTES

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MARCONI INSTITUTE
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Technical Lesson 43

RADIOLA 28

A. C. Operated

The Radiola 28 may be converted for complete alternating current operation by installing the A.C. package and employing the type 104 speaker. The A.C. package, consisting of the following parts, can be used only with the Radiola 28.

- (a) 1 Condenser unit with attached terminal board.
- (b) 1 Resistance rod used for battery setting rheostat.
- (c) 1 Cable to make connection between condenser and tube socket unit terminal boards.
- (d) 1 Volume control rheostat.
- (e) 1 UP-591 resistance unit.
- (f) 1 Resistance strip for connecting to special screw terminals on rear of tube socket unit.
- (g) 4 Round-head wood screws for mounting condenser unit.

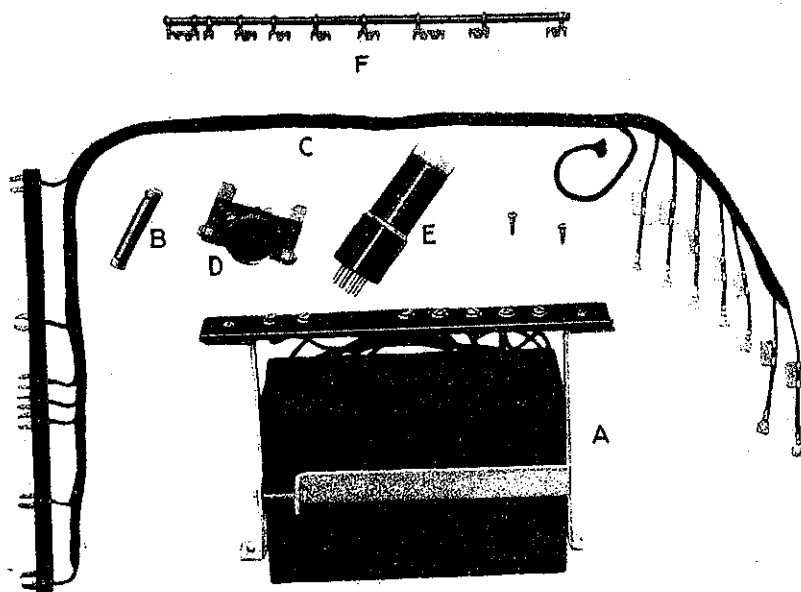


Figure 1

These parts are shown in Figure 1. They can be used in conjunction with the 28 only when employed with the loudspeaker model 104, and only on a house lighting circuit of proper voltage and frequency, namely: 105 to 125 volts, 50 to 60 cycles A.C.

There are five operations in converting the 28 receiver from a battery

operated set to one that depends upon the A.C. lighting source for its complete operation. They are classified as follows:

- 1st. Remove the operating panel.
- 2nd. Necessary changes in the receiver unit.
- 3rd. " " " " cabinet.
- 4th. Replacement of the panel.
- 5th. Changes in the 104 loudspeaker.

Complete instruction for the conversion follow in the order as mentioned above.

First: The loop antenna must be removed from its socket, allowing the lid of the receiver to be raised so that all tubes may be removed. A metal guide cup at the top of the loop socket may in some models extend above the lower edge of the wood cross piece which extends across the front of the cabinet. If such is the case the metal cup will have to be removed before the panel can be withdrawn from the cabinet. To accomplish this take out the round head screws found at the bottom of the cup. Upon completion of the above detail raise the entire upper section of the cabinet until it locks itself in the open position by means of the stay arm S, Figure 2.

This brings to view the battery compartment. Disconnect and remove all

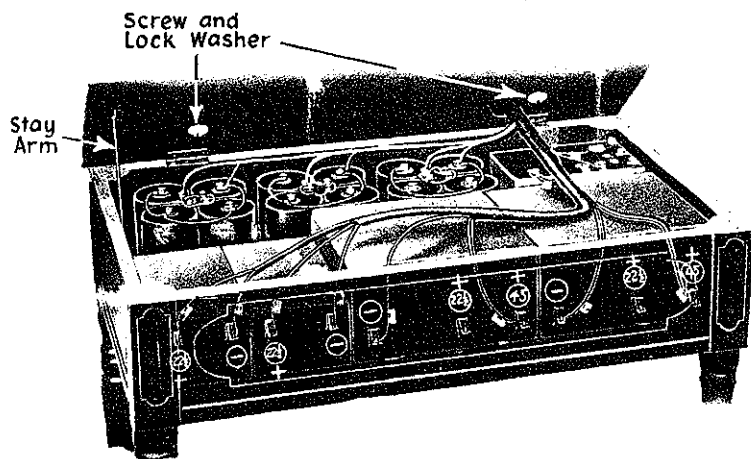


Figure 2

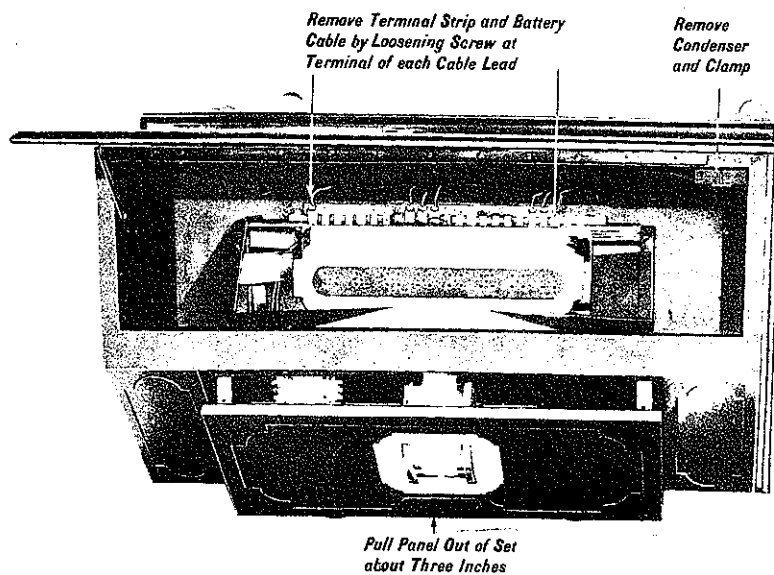


Figure 3

of the batteries; also remove the four screws and lock washers which will be found on the under side of the raised section of the cabinet. Two of these screws are shown in Figure 2. Release the stay arm and lower this section to the closed position.

Raise the lid of the cabinet next and gently force the panel and receiving unit forward about three inches. This will make possible the loosening

of all the screws securing the terminals of the battery cable to the terminal strip at the rear of the tube socket unit. See Figure 3. The cable and its associated terminal strip is now removed from the terminal board which allows the panel and receiving unit to be completely withdrawn from the cabinet.

One more operation is necessary before the changes in the receiver unit can be made. This involves the removal of the clamps holding the cable, just disconnected from the terminal board and the removal of the condenser and fittings shown in the upper right hand corner of Figure 3.

To make the changes in the receiver unit proceed as outlined below.

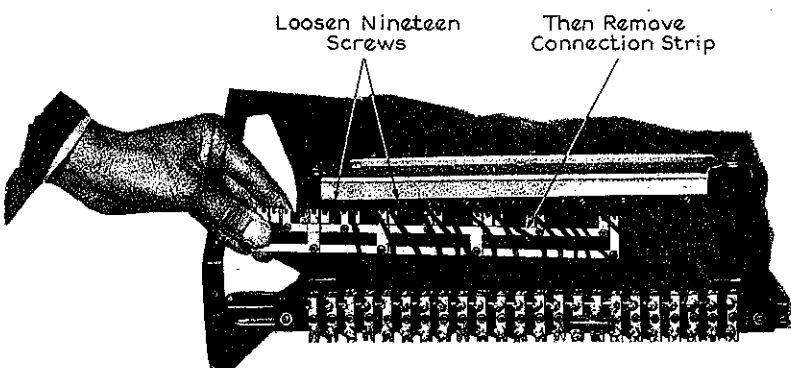


Figure 4

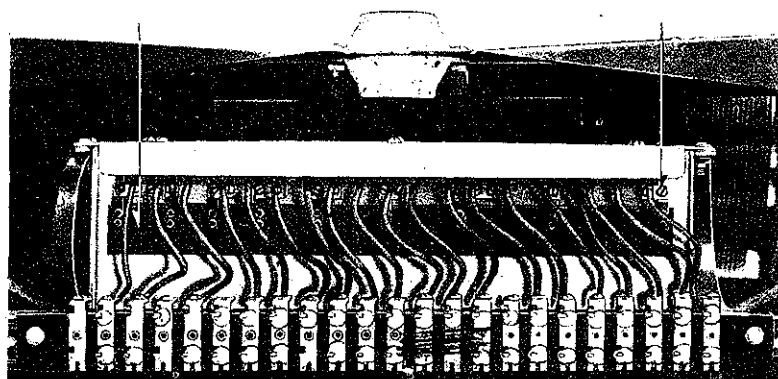


Figure 5

At the rear of the tube socket unit will be found a terminal connection strip which is secured in place to the terminal board by nineteen screws. Carefully loosen all of these screws and remove the strip by sliding it out of one side of the unit as shown in Figure 4. Substitute in its place the resistance strip, a view of which is shown in Figure 1, designated by the letter "F". Figure 5 shows the resistance strip "F" in place. Lock the strip securely in place by tightening the nineteen screws.

Next remove the wire wound resistor rod found in the battery setting rheostat, Figure 6, and substitute in its place the rod B of the accessories shown in Figure 1, taking special precaution to so place the rod that the contact arm rides on the bared part of the enameled wiring, thus making a good electrical contact.

Work on the volume control next. A soldering iron is necessary in this operation to unsolder the two leads connected to the volume control rheostat. Remove this rheostat from the panel and substitute in its place the rheostat supplied with the A.C. package shown in D, Figure 1, and resolder the leads which were removed from the old rheostat. As these leads may be reversed it is not necessary to take special precautions to replace them exactly as originally found.

On the filament switch shown in Figure 6 unsolder either one of the two leads and resolder it to the same connector as the other lead, then unsolder and tape the end of the lead which was connected to the voltmeter clip nearer the volume control, but do not disturb the connection to the voltmeter clip nearest the battery setting rheostat.

In this particular set open wiring is shown under the panel. Other sets may have braided cable in place of the exposed wiring as shown in Figure 6. The changes in either case, however, are made in exactly the same manner.

CABINET CHANGES

A $\frac{3}{4}$ inch hole must be drilled through the bottom of the battery compartment to allow the cable of the 104 loudspeaker to be brought through,

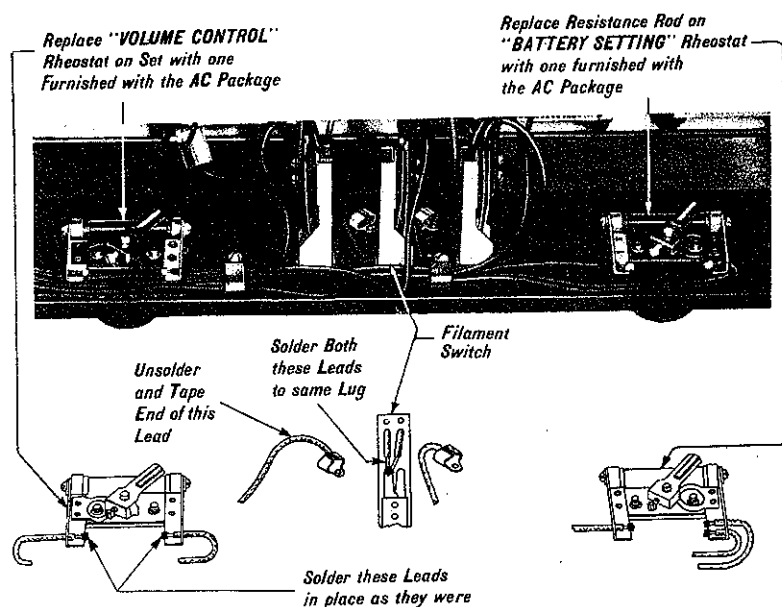


Figure 6

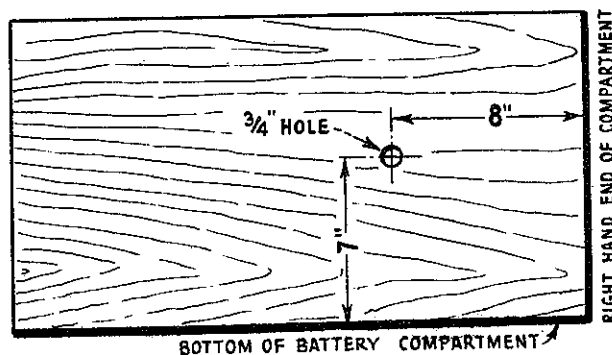


Figure 7

unless the cabinet is already so equipped. Measurements for locating the position of this opening are shown in Figure 7.

Locate the condenser pack A, shown in Figure 1, near the right hand end of the battery compartment as shown by the view in Figure 8, securing it in place by means of the four round head wood screws G, Figure 1, which hold the metal brackets of the pack to the floor and the inside front section of the cabinet.

REPLACING THE PANEL

Release the stay arm and lower the upper compartment, and replace the panel and receiving unit in the cabinet. Leave the panel projecting about three inches as shown in Figure 9 and connect the terminal strip of the short cable D, Figure 1, to the receiver terminal board being sure

that the terminal lugs of the cable line up with the terminals of the receiver terminal board in such a manner that the yellow lead with the red tracer is connected to the terminal at the extreme left hand side of the terminal board of the receiver. Refer to Figure 8. Inspect all screws to see that they are well seated. The other end of this cable D, Figure 1, is fed through the opening in the floor near the back of the cabinet, and the receiver pushed all the way in. Close the lid and again raise the upper section of the cabinet and lock it in place by the stay arm. Replace the four screws and lock washers which hold the receiver unit and panel in place.

Before going further, make certain that the 104 speaker is not connected to the lighting circuit. Then remove the terminal board from the end of the input cable of the 104 loudspeaker. (Note: This terminal board will not be used unless it is equipped with a separate five foot telephone cord attached to two terminals. Input terminals are not furnished on the terminal board of the condenser unit).

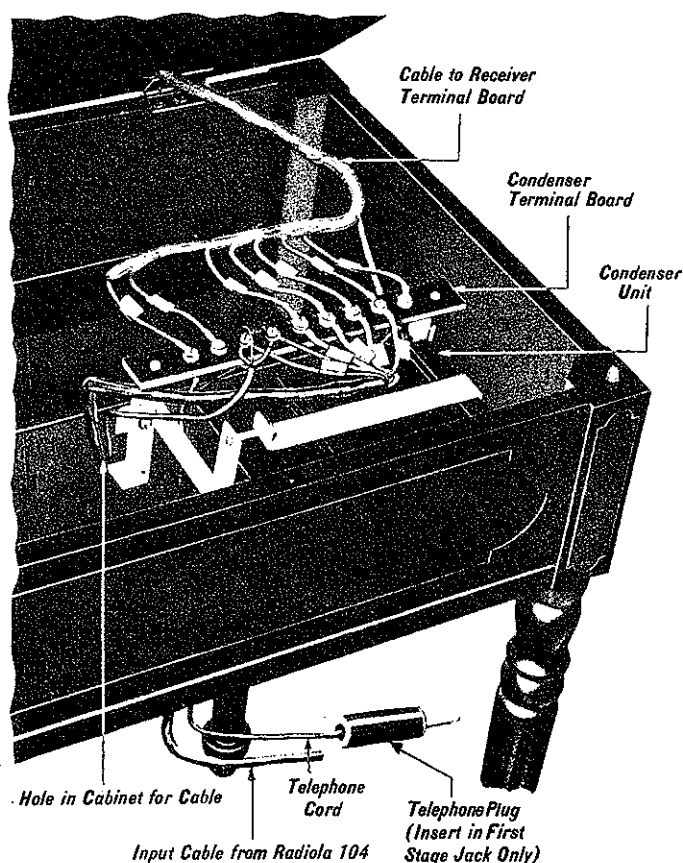


Figure 8

Force the end of the cable through the $\frac{3}{4}$ inch opening in the floor of the battery compartment and connect the leads of both the 30 foot input cable and the short cable from the receiver terminal board of the condenser unit, shown in Figure 8, making certain that the marking on each metal tag of the cable agrees with that on the condenser terminal board.

There are two types of input cables supplied with different models of the 104 loudspeaker. In one type the telephone cord emerges from the 30 foot cable, extending several feet, at the end of which is connected a telephone plug. When this type of cable is supplied the two input terminals on the condenser terminal board are left vacant and it is necessary only to insert the phone plug in the first audio stage jack of the receiver.

The other type of input cable which is illustrated in Figure 8, has two short leads with metal tags marked "INPUT", one brown and the other black with a brown tracer. A separate five foot telephone cord with a telephone plug on one end is furnished with this type of input cable. At the other end two leads, one brown and the other black with brown tracer, are equipped with spade terminals. This end of the cord is passed up through the hole in the floor of the battery compartment.

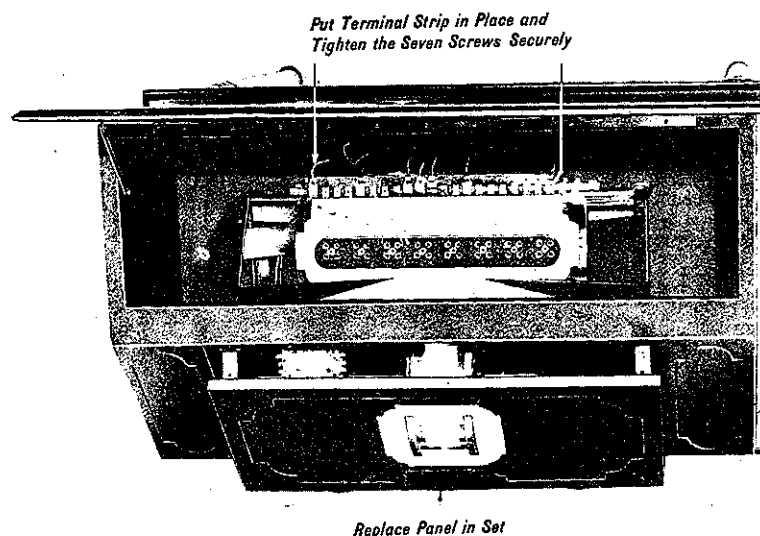


Figure 9

Connect the two brown leads to one of the input terminals of the condenser unit and the two black leads with the brown tracer to the other input terminal.

Note: If the condenser terminal board is not equipped with "INPUT" terminals, use the two "INPUT" terminals on the loudspeaker 104 terminal strip (originally connected to the end of the 30-foot input cable) to join the leads from the five-foot cord to the "INPUT" leads of the 30-foot input cable. If this method is used, tighten the two "INPUT" terminals securely, then wrap insulating tape round the exposed connections. The tie cord at the end of the telephone cord should be fastened to a portion of the condenser bracket and the short terminal strip allowed to rest on the cabinet floor.

A tie cord at the end of the five foot telephone cord is supplied which should be secured around the condenser terminal board so as to relieve

any strain that might be placed on the electrical connections made to the condenser terminal board by a sudden jerk or undue strain of the cord.

When all connections to the condenser terminal board are made tight, lower the raised portion of the cabinet, insert the telephone plug attached to the five foot cord into the first audio frequency jack, (the left hand jack) and insert the UX-199 tubes in sockets 1 to 7, socket No. 1 being on the extreme left as you face the front of the set.

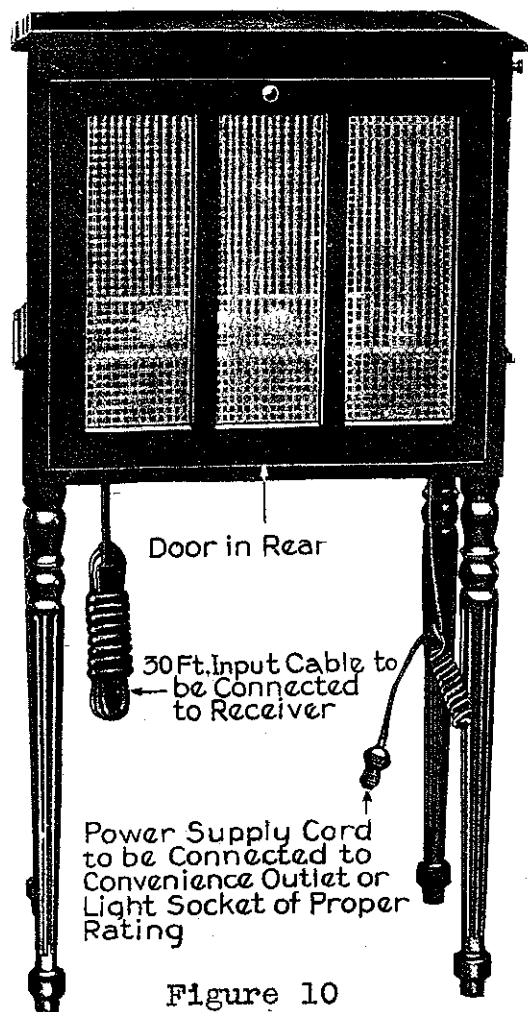


Figure 10

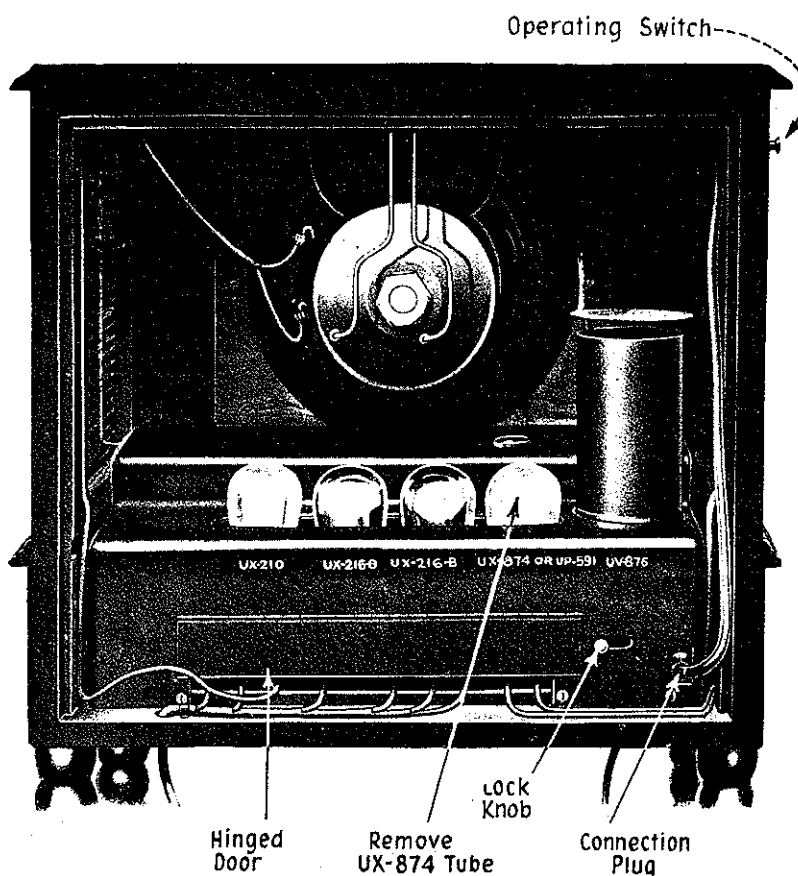


Figure 11

Do not place any tube in the extreme right hand socket, in which the UX-120 is used, when the set is operated on dry cells, as the additional amplification is now obtained by means of the UX-210 located in the Power Amplifier Unit of the 104 loudspeaker. The lid of the set can now be closed and the loop replaced.

CHANGES NECESSARY IN THE 104 SPEAKER

Open the rear door of the 104 loudspeaker, Figure 10, and remove the UX-874 tube, Figure 11, replacing it with the UP-591 unit, Figure 12. This unit is shown fully in E, Figure 1.

The order of the tubes and the resistance unit in the power amplifier from left to right should now be: UX-210, UX-216-B, UP-591 and UV-876 if the power supply is 50 to 60 cycles, 105 to 125 volts alternating current. A UV-886 is used instead of the UV-876 if the power supply is 40 to 50 cycles, 105 to 125 volts, A.C. The extreme right hand tube of the power amplifier unit will therefore depend upon the frequency of the light circuit mains. The UV-876 should never be used when the frequency of the lighting circuit is less than 50 cycles. The next step is to remove the connection plug at the lower right hand corner of the power amplifier and push the lock now to the right. This permits the raising of the hinged door as shown in Figure 11. With the hinged door opened, as shown in Figure 13, remove the filament connecting link which connects the fifth and sixth terminals from the left of the power amplifier terminal board. Be sure to retighten the screws which held this connecting strap in place; also inspect all other screws on this board to make sure they are well tightened. Close the hinged door, push the lock knob to the left, and reinsert the connection

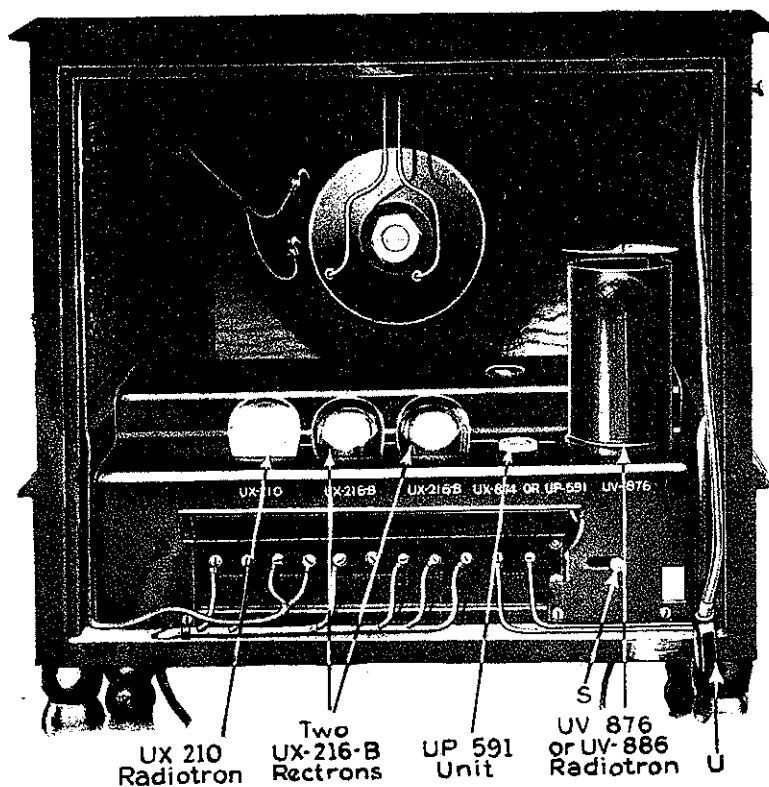


Figure 12

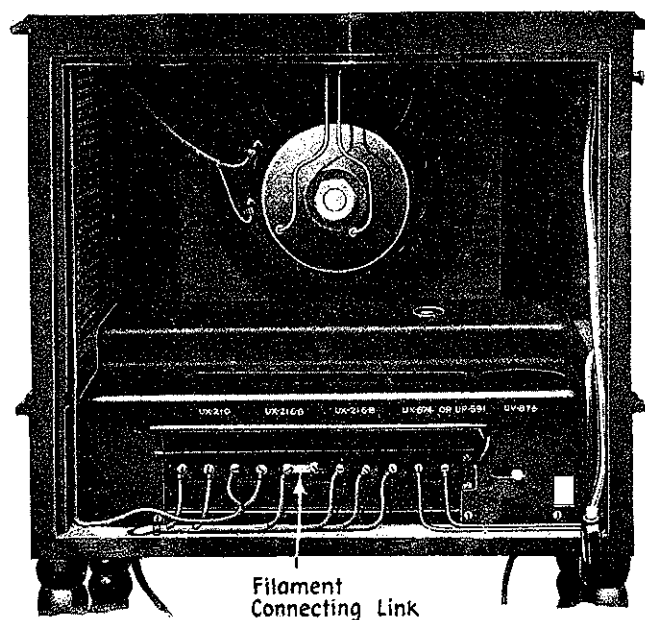


Figure 13

plug in its socket. The power amplifier will now appear as shown in Figure 11. Replace the rear door of the loudspeaker cabinet, a view of which is shown in Figure 10, and insert the eight foot attachment plug, Figure 10, in a convenient light socket.

With the foregoing instructions followed the set is now ready for operation. The current supply for the entire combination is turned on or off by means of the operating switch on the side of the 104 speaker. The location of this switch is shown in Figure 11.

The operating characteristics of the A.C. operated Radiola 28 is exactly the same as when dry batteries are employed, with the exceptions as outlined below.

- (a) The filament switch on the receiver will not turn the current ON or OFF.
- (b) The battery setting rheostat will not turn the current off. Before the operating switch of the loudspeaker is turned ON the battery setting rheostat should always be turned OFF because the filament current may be at first excessive. When the set has been in operation for a short interval of time the battery setting rheostat should be advanced.
- (c) The filament voltage cannot be measured at the filament voltmeter jacks as was the case when the set was battery operated.
- (d) No tube is used in No. 8 socket, (the extreme right hand socket).
- (e) Signals cannot be heard from the second audio frequency jack. The plug on the cord from the 104 speaker is always plugged in the first audio frequency jack.

If the installation of the A.C. package UP-972 has been carefully carried out there should be no difficulty experienced in operating the 28 A.C. set. If difficulty should be experienced in the operation of the set, the following tests may be applied to locate the trouble.

TEST FOR VOLTAGE READINGS

The following voltage readings should be obtained when voltmeter readings are taken across the terminal strip at the back of catacomb. The terminals are counted from left to right when facing the set. A high resistance voltmeter of at least 600 ohms resistance per volt, or the "no current voltmeter", which will be described in a subsequent paragraph, should be used when making these tests.

A variation in the voltage readings obtained is allowable, which may be 5 volts higher or 5 volts lower than normal. When making this test follow the diagram in Figure 14.

TEST NO. 1

With positive lead
of voltmeter on
terminal number

And negative lead
of voltmeter on

With the battery
setting near "Off"
and all tubes lit,
the voltmeter should
read

1	21	31 volts
10	1	21.5 "
11	10	41 "

EXPLANATION OF TEST NO. 2

This test will indicate whether the external connections to the catacomb are complete and will also show whether the connections inside the catacomb proper are correct.

When reference is made to terminal numbers it refers to the terminal strip at the rear of the catacomb and the count is made as before from left to right.

Before conducting the test the operator must make certain that the volume control rheostats and filament control rheostats are adjusted so that half their resistance is cut in the circuit. The loop must be removed from its socket and the cable disconnected from the terminal strip at the back of the catacomb.

The two methods mentioned in previous lessons may be used to conduct the test, namely, the click test which employs phones and a $4\frac{1}{2}$ volt dry battery, or by the use of the high resistance voltmeter, capable of giving a full scale deflection.

The click method will be used in this lesson. Reference should be made to Figure 14 continually while making the continuity check.

The first part of test No. 2 will take in the condensers of the catacomb. Be sure to disconnect the cable. Remove all tubes and remove the loop.

TEST NO. 2

With one test tip on	And the other test tip on	Between these points	If a click is heard it indicates that
The plate contact of tube socket No. 6	The positive terminal No. 6	No click	Condenser No. 3 or No. 4 inside the catacomb is short circuited
Terminal No. 9	The plate contact tube socket No. 2	No click	The neutralizing condenser within the catacomb is short circuited
Terminal No. 9	The grid contact of tube socket No. 6	No click should be heard, a faint click may be heard if so the test is O.K.	If a pronounced click is heard the grid condenser of the detector is short circuited
Terminal No. 14	Terminal No. 11	Circuit should be open hence no click should be heard	If test indicates closed circuit condenser No. 1 is short circuited



Lesson 43 - sheet 11

SECOND TEST NO. 2

The second part of test No. 2 includes the tuning inductances within the catacomb together with the connections pertaining thereto. Before conducting this test be sure that the tubes are removed from their sockets, the cable disconnected from the catacomb terminal strip, and the loop removed from its socket.

With one test tip on	And the other test tip on	The result obtained should indicate	If no click is heard
Terminal No. 2	The grid contact of tube socket No. 1	Closed circuit; i.e., a click should be heard	The lead between these points is open
Terminal No. 6	The grid contact of tube socket No. 3	"	"
Terminal No. 7	The plate contact of tube socket No. 3	"	"
Terminal No. 9	The grid contact of tube socket No. 2	"	Either the low-half of coil No. 2, the connecting leads leading to or from the coil, or that portion of the resistance strip lying between position 4 and 5 is open.
Terminal No. 9	The grid contact of tube socket No. 4.	Closed circuit, i.e., a click should be heard	Either coil No. 4, connecting leads, or that portion of resistance strip lying between positions 5 and 6, is open.
Terminal No. 10	The plate contact of tube socket No. 1	"	Coil No. 1 or connecting leads open.
Terminal No. 10	The plate contact of tube socket No. 6	"	Coil No. 7 or connecting leads open.
Terminal No. 11	The plate contact of tube socket No. 2	"	Coil No. 3 or connecting leads open.

Terminal No. 11	The plate contact of tube socket No. 4	A closed circuit; i.e. a click should be heard	Coil No. 5 or connecting leads open
Terminal No. 11	Terminal No. 17	"	Coil No. 9 or connecting leads open
Terminal No. 12	The grid contact of tube socket No. 5	"	Lead between these points open
Terminal No. 13	The plate contact of tube socket No. 5	"	Lead between these points open
Terminal No. 16	The plate contact of tube socket No. 7	"	Lead between these points open
Terminal No. 18	The plate contact of tube socket No. 8	"	Lead between these points open
Terminal No. 20	The grid contact of tube socket No. 8	"	Coil No. 10 or connecting leads open
Terminal No. 22	The grid contact of tube socket No. 7	"	Coil No. 8 or connecting leads open

THIRD TEST No. 2

This part of test No. 2 enables the operator to check the continuity of all coils, connecting leads, telephone jacks, and filament control rheostat, which are parts exterior to the catacomb. It is called the "panel test". Before conducting the test remove all tubes and the loop, disconnect the cable from the catacomb terminal strip, and remove the resistance strip.

With one test tip on	And the other test tip on	The results obtained should indicate	If <u>no</u> click is heard
Terminal No. 3	Terminal No. 2	Closed circuit; i.e., a click should be heard	The first radio frequency coil No. 13 or connecting leads open
Terminal No. 5	Terminal No. 4	"	The volume control rheostat open

Terminal No. 11	Terminal No. 7	Closed circuit; i.e., a click should be heard	The radio frequency coil No. 14 or connecting leads open
Terminal No. 13	Terminal No. 11	"	The oscillator coil No. 11 or connecting leads open
Terminal No. 14	Terminal No. 12	"	The oscillator coil No. 12 or connecting leads open
Terminal No. 16	Terminal No. 11	"	The first audio frequency jack or connecting leads open
Terminal No. 17	Terminal No. 16	"	The first audio frequency telephone jack defective

Note: Before testing between terminals 17 and 16 first insert a telephone plug that has been short circuited in the first audio frequency telephone jack.

Terminal No. 22	Terminal No. 21	Closed circuit., i.e. a click should be heard	The filament control rheostat open
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On making this test remove the short circuited telephone plug from the first A.F. jack.

FOURTH TEST No. 2

Part four of test No. 2 serves the purpose of checking the condensers. To conduct this test it is necessary to remove only the loop from its socket.

With one test tip on	And the other test tip on	The result obtained should be	If a click is heard
Terminal No. 8	Terminal No. 6	An open circuit; i.e. no click should be heard	Either the loop condenser or the compensating con- denser is short circuited
Terminal No. 8	Terminal No. 7	"	The small neutral- izing condenser between these terminals is short circuited

TEST NO. 3

It is sometimes necessary, when shooting trouble on this set, to check the value of the various sections of the resistance strip which is mounted directly behind the catacomb. One of the simplest means of determining the resistance of an appliance is to pass a current through it. The current is measured with an ammeter, and the voltage by means of a voltmeter. The resistance is then found by applying Ohm's Law.

$$R = \frac{E}{I}$$

This method is called the "Voltmeter-ammeter" method and is the one which will be described to measure the values of the resistance strip shown in Figure 14.

A voltmeter having a scale of 0 to 7 and milliammeter with a scale of 0 to 500, should be used and connected in the circuit as shown in Figure 15. Since a milliammeter is used the current reading taken is in milliamperes; i.e. 1/1000 ampere. It is necessary to multiply the product of E/I by 1000 to obtain the resistance value in ohms.

The complete formula, therefore, is written as follows:

$$R = 1000 \times \frac{E}{I}$$

Where R = Resistance in Ohms

E = E.M.F. in Volts

I = Current in Amperes

There are nine terminals on the resistance strip numbered 1 to 9, inclusive, counting from the left to right when facing the front of the set. The values that should be obtained between the various terminals are given below. An actual test taken between terminals No. 1 and No. 2 is shown in Figure 15.

TEST NO. 3

With one test tip on	And the other test tip on	The value in Ohms should be	The lowest value permissible for proper function of set is	The highest value permissible for proper function of set is
Terminal No. 1	Terminal No. 2	190 Ohms	185 Ohms	195 Ohms
*Terminal No. 2	Terminal No. 3	400 "	350 "	450 "

Terminal No. 3	Terminal No. 4	163 Ohms	158 Ohms	168 Ohms
Terminal No. 4	Terminal No. 5	155 "	150 "	160 "
Terminal No. 5	Terminal No. 6	130 "	125 "	135 "
Terminal No. 6	Terminal No. 7	120 "	116 "	124 "
Terminal No. 7	Terminal No. 8	115 "	111 "	119 "
Terminal No. 8	Terminal No. 9	50 "	45 "	55 "

* This test applies to the models in which the resistance strip is not left open. The volume control in this instance has a resistance value of 375 ohms. In models in which this strip is left open the volume control should have a resistance value of 187.5 ohms. In other models of the Radiola 28 receiver where the volume control has a value of 250 ohms resistance the following set of resistance values should be read between terminal lugs.

With one test tip on	And the other test tip on	The value in ohms should be	The lowest value permiss- ible for proper function of set should be	The highest value permiss- ible for proper function of set should be
Terminal No. 1	Terminal No. 2	271 Ohms	260 Ohms	282 Ohms
Terminal No. 2	Terminal No. 3	Left open	Left open	Left open
Terminal No. 3	Terminal No. 4	236.5 Ohms	230 Ohms	243 Ohms
Terminal No. 4	Terminal No. 5	197 "	191 "	203 "
Terminal No. 5	Terminal No. 6	183.5 "	176 "	191 "
Terminal No. 6	Terminal No. 7	154.5 "	146 "	163 "
Terminal No. 7	Terminal No. 8	145.5 "	137 "	154 "
Terminal No. 8	Terminal No. 9	50 "	45 "	55 "

The resistance strips are all interchangeable providing the volume control resistance used with the strip is of the correct value. The method of determining the correct value of the volume control has been explained in the forgoing resistance strip tests.

TROUBLES TO LOOK FOR FIRST

When conducting tests in an effort to locate a possible source of trouble, and more particularly where voltage tests taken at the catacomb terminal strip indicate trouble, a recheck should be taken to make sure that the first test was correct. This may be determined by taking voltage readings at the terminal strip of the condenser bank and also at the terminal board of the Rectifier Power Amplifier (R.P.A.) unit which is located in the 104 loudspeaker cabinet. If the voltage readings at these three points are the same it is a good indication that the trouble is in the R.P.A. unit and is not being caused by a possible defect in either the cable or condenser bank.

Examination should be made of the cable, accompanying the A.C. package, which connects the catacomb terminal strip of the set to the condenser bank, and the 30 foot cable connecting the condenser bank to the Rectifier Power Amplifier unit of the loudspeaker, to determine the condition of the leads at the ends of these cables. If the ends of these cables are worn or the terminals soldered to each other are corroded or loose, proper measures should be taken to restore them to good condition.

PROBABLE CAUSES OF HIGH, LOW, OR NO VOLTAGE READINGS TAKEN AT THE TERMINAL STRIP OF THE SET.

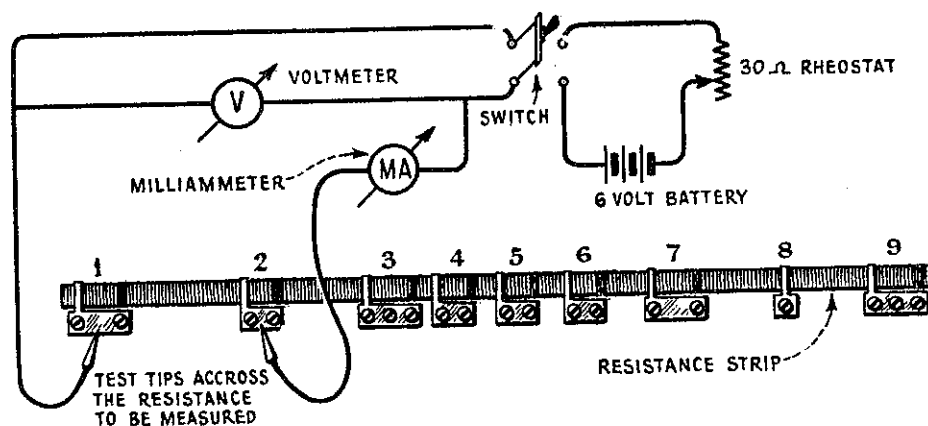


Figure 15

Any one of the above conditions may be the result of defects in the A.C. package, or in the Rectifier Power Amplifier unit.

A test taken at the terminal board of the Rectifier Power Amplifying unit located in the 104 loudspeaker cabinet will indicate whether the trouble is in the cable or in the condenser bank of the A.C. package.

When the condenser bank or cable is found to be clear of trouble the test should then be extended to the Rectifier Power Amplifier unit when the following conditions should be observed. (The tube filaments should be burning at normal brilliancy and otherwise functioning normal).

If no voltage reading is obtained at the terminal board of the Rectifier Power Amplifier unit, the cause may be due to:

- (1) The resistor unit UP-591, which is found in the place of tube UX-874, may be short circuited.
- (2) Look for an open connection at the terminal board of the R.P.A. unit.
- (3) The 7 mfd. or 4 mfd. filter condenser may be broken down or short circuited which condition would be indicated by the plate element of the UX-216-B becoming excessively hot.
- (4) The 2 mfd. condenser of the pack might be short circuited when a voltage reading below normal is obtained at the R.P.A. unit terminal board.
- (1) Look for trouble in the power transformer in the nature of short circuited turns in the high voltage windings.
- (2) Check the UX-216-B tubes for sub-normal electron emission.
- (3) Test the 7 mfd. and 4 mfd. filter condenser to determine if they are in a leaky condition.
- (4) The 2 mfd. condensers may be in a leaky condition.
- (5) Check all resistance units for defects.

When the voltage test at the terminal board of the R.P.A. unit indicates a voltage in excess of the high voltage limit the cause may be found in:

- (1) A defective pot magnet of the loudspeaker.
- (2) The resistance units may be defective.
- (3) The primary turns of the power transformer may be short circuited.
- (4) The resistance units, R2 or R3, may be open.

For those who do not possess a high resistance voltmeter with which to measure the plate or filament voltages of the A.C. operated Radiola 28 constructional details are herewith given.

The circuit with its associated parts is shown in Figure 16. It consists of a 0 to 7.5 voltmeter, equipped with a multiplier (that the lower scale may be used to read voltages up to 150 volts, D.C.), a galvanometer,

potentiometer, safety resistance, reversing switch, and a UX-199 plug; also an external voltage supply in excess of that to be measured.

When the UX tube base is employed to measure the filament voltage of a UX-199 tube it is necessary to have a resistance unit of 50 ohms connected across the filament terminals of the UX base. This resistance, shunted across the filament terminals of the UX base acts as a compensating device, supplying the loss of filament resistance due to the removal of the UX-199 tube from its socket in the set.

When the measurement of any D.C. voltage is undertaken the following rules should be observed:

(1) The voltmeter scale, covering the voltage to be measured, should be used; that is, when any voltage from a maximum value of 7.5 volts to zero is to be read, use the top scale. When 7.5 volts, and up to and including 150 volts is to be read, use the multiplier and read the bottom scale.

(2) When the UX plug connected across the terminals marked "test", Figure 16, is not in use disconnect it, and also the 50 ohm compensating resistance.

(3) Adjust the potentiometer until the voltmeter gives a reading as near as possible to that of the voltage to be measured.

(4) Then connect the external voltage supply to the binding posts marked "battery".

(5) Connect the flexible leads to the proper terminals of the voltage to be measured and set the reversing switch on the contacts giving correct polarity to the meters.

(6) Then with the push button open, across which the 1,000 ohm protective resistance is shunted, adjust the potentiometer until zero reading is obtained on the galvanometer. With the galvanometer reading at zero close the protective push button and again adjust the potentiometer until the galvanometer reads zero.

Upon completing this function the voltmeter can be read which will be the correct voltage of the circuit upon which measurement is being made.

The operating theory, when measuring the filament voltage of an A.C. operated catacomb, is the same as the foregoing with the exception that the compensating resistance and the UX tube base is utilized to supply the circuit with the source of voltage to be measured.

The theory upon which the "no current voltmeter" operates is based on the condition that if an external voltage is applied through a suitable circuit so that it will be made to oppose the voltage of the circuit under measurement the galvanometer will indicate zero when the two voltages are exactly the same. The purpose of the voltmeter connected across the circuit, through which the opposing voltages flows, is to provide a

simple means for determining the external voltage necessary to produce an exact electrical balance in the circuit under measurement. The remainder of the lesson is devoted to troubles and remedies, which may be classified as follows:

- (a) Howling
- (b) Blasting
- (c) Fading of signals
- (d) Fluttering
- (e) Loudspeaker

(a) Howling in many instances is caused by the sound waves emitted from the loudspeaker which, on passing the tube, may set its elements; i.e. filament, grid or plate, in actual mechanical vibration. This vibration happens because one or more of the elements are loose in their mountings and, being loose, the vibrating action changes the spacing between the vibrating element and the other elements of the tube. When this happens the amplification factor of the tube is changed and a low hum perhaps is the first indication of this trouble which builds up in volume until a terrible howl results in the loudspeaker which can be of sufficient magnitude to entirely drown out the voice or music.

Locating the microphonic tube, as the tube is called which lends itself to mechanical vibration, interchange it for one of the tubes in the intermediate or radio frequency stages; this will in most instances eliminate the trouble.

(b) Blasting is a condition which may be found to arise when the volume control is adjusted to the point of maximum, or nearly maximum volume, and also when the signals are being received from broadcasting stations located near the receiver.

This fault can, in practically all cases, be overcome and the receiver restored to normal action by interchanging the tubes. Replacing the UX-210 by another may also clear up the trouble. Increasing or changing position of the loudspeaker will in some installations eliminate the trouble.

It sometimes becomes necessary to make use of a choke coil to prevent blasting. This is connected across the catancomb terminal strip between terminals No. 10 and No. 16. The impedance of this choke is the same as that of the primary winding of a model 104 loudspeaker input transformer.

(c) Fading of signals in this instance does not refer to the natural fading phenomenon, nor to the reduction in signal strength which occurs due to the normal drop taking place shortly after the 104 speaker has been placed in operation, but takes into account a defective UV-876 or UV-886 tube as the cause of this deficiency.

A defective UX-210 tube may also cause this trouble in which case the tonal qualities of the reproduced signal will be greatly impaired, giving unnatural and harsh reproduction.

The resistance units in the Rectifier Power Amplifier unit will also have the tendency to cause fading and can be generally traced by the excessive heat created in the defective resistor. This applies to all the resistors in the amplifier pack with the exception of unit R₄ which, due to its design, becomes very hot during normal operation.

(d) When the tuning condensers in an A.C. installation are manipulated they bring their particular circuit to a resonant condition. Fluttering will occur in some of the A.C. operated 28 sets when this condition is reached and is recognized by a loud A.C. 60 cycle hum. To correct this fault any means may be taken that will change the electrical characteristics of the audio frequency circuits.

The remedies which follow are suggested as a means to prevent fluttering.

(1) Make a complete interchange of the UX-199 tubes.

(2) Counting from the left to right on the catacomb terminal strip locate terminals 10 and 15 and connect a choke coil across these terminals. A choke coil having an inductance of from 30 to 50 henrys will answer the purpose.

(3) A further remedy to be tried, if the above two fail, is to connect in a series arrangement a condenser having a capacity of 2 mfd. and a choke having an inductance of 30 henries. Connect the free lead of the choke to terminal 15 of the catacomb terminal strip and the free lead of the 2 mfd. condenser on terminal 22 of the catacomb terminal strip.

(4) Change the A.C. package.

(e) Loudspeaker distortion may be caused by some fault in the loudspeaker reproducing unit itself, or it may originate due to a certain condition of the cone. Several reasons are advanced as possible causes, any one of which may be the true cause, or it may happen that two or more causes are acting together to produce the result called "distortion".

First: the distortion may be the result of a faulty input from the set proper; a check should be made to determine whether this is the case.

Second: the 2 mfd. condenser in the condenser block of the Rectifier Power Amplifier unit located adjacent to the 7 mfd. condenser may be found defective. It should be tested and replaced by a perfect unit if found defective.

Third: the UX-210 rectifier tube may be defective. If so it must be replaced by a new one.

Fourth: the movable coil on the throat of the cone may, due to bad alignment,

scrape against the pot magnet pole pieces thus short circuiting them. If this condition exists the entire cone must be replaced by a new one.

Fifth: two small leads run from the edge of the cone to the movable coil at the throat of the cone. They may for some reason break away from the cone surface to which they are secured. The remedy is to fasten them in place by shellac.

Sixth; the cone itself may not be properly aligned. This condition can be rectified by adjusting the small round head screw in the center of the cone.

EXAMINATION - LESSON 43

1. Can the A.C. package be used with any set?
2. What change is made in the volume control rheostats when converting the Model 28 for A.C. operation?
3. What may be used in place of the UX-874 tube?
4. Does the filament switch on the set control the filament current after the set has been converted for A.C. operation?
5. When making a test of the external catacomb connections what should be done with the volume and filament control rheostats?
6. What two methods may be used to conduct a continuity test?
7. Give three reasons why no voltage reading may be obtained at the terminal board of the R.P.A. unit.
8. What in your estimation will cause this set to howl?
9. Why is it sometimes necessary to interchange tubes from one socket to another.
10. State two conditions that might cause distortion in this set.

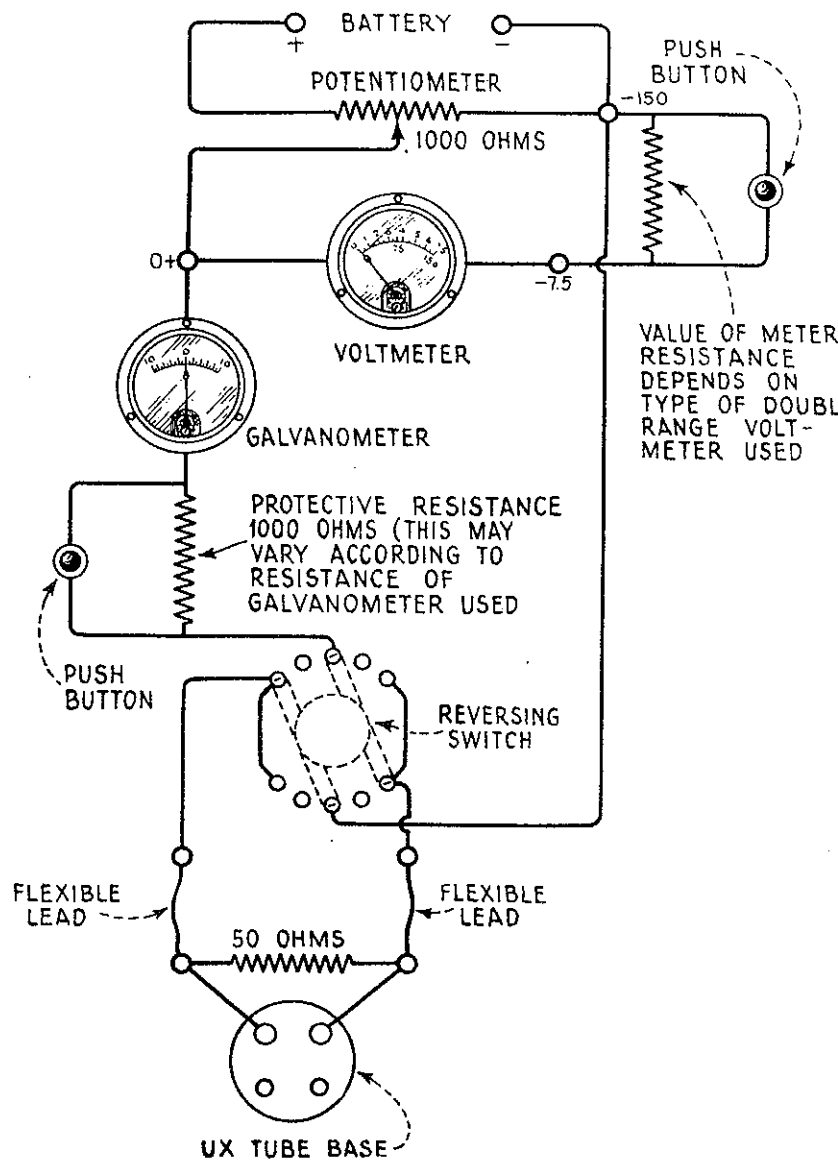
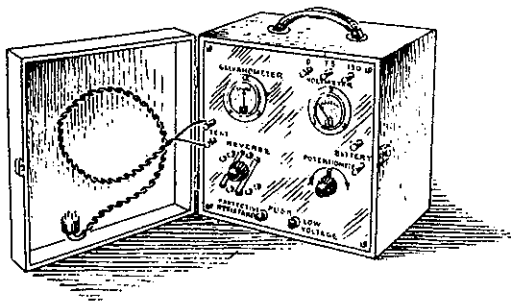
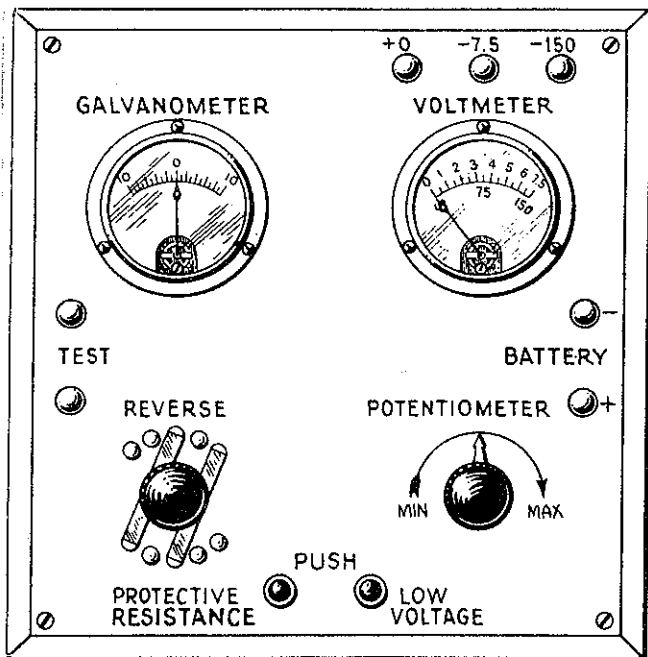


Figure 16

TECHNICAL LESSON 43